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**LISTS OF SPECIES**

# Amphibia, Anura, São Desidério, western Bahia uplands, northeastern Brazil

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**Abstract:** The contact zone between *Cerrado* and *Caatinga* is among the least known areas in the *Cerrado* biome, and no information is available about the anuran species occurring in this area and their ecology. Along this area, seasonally dry tropical forests are common on the lowlands with some enclaves inside the *Cerrado* core area. Here, we present for the first time a list of species on this zone recognized as a priority area for conservation inside the *Cerrado*. We sampled anuran species within 30 km of São Desidério, a city in western Bahia, from habitats including temporary and permanent ponds in *Cerrado* and seasonally dry tropical forests, as well as veredas and marshes. We recorded 32 anuran species, belonging to 12 genera in five families. Hylidae was the richest family (ten species) followed by Leiuperidae and Leptodactylidae (eight species each), Bufonidae (five species), and Microhylidae (two species). The heterogeneity of this site could be demonstrated by the presence of species with different dispersal/colonization history with eight species (25 %) endemic to *Cerrado*, three (9 %) shared with *Caatinga* biome, two (6 %) shared with Atlantic Forest, and eighteen (56 %) widespread through adjacent biomes.

## Introduction

Geographical, evolutionary and historical processes in a region are important determinants of community assembly, influencing both local and regional diversity (Ricklefs and Schluter 1993). When located at the edge of a phytogeographic domain, the species composition of communities will be influenced by regional processes, like speciation, dispersal and immigration, both within the domain, and between adjacent domains (Lomolino et al. 2005). Therefore, the spatial dynamics of local communities may allow the coexistence of dispersing species from different regions with different abilities to use available resources in a heterogeneous landscape (Leibold et al. 2004).

The *Cerrado* is a large phytogeographic domain dominated by savanna vegetation located in the center of South America, bordering other open and forested biomes such as *Caatinga*, Atlantic Forest, *Pantanal*, *Chaco* and *Amazonia*. The contact zone between *Cerrado* and *Caatinga* extends largely through the states of Piauí, Bahia, and Minas Gerais in Brazil and represents one of the least known areas in the *Cerrado* biome. At the lowlands of this contact zone, seasonally dry tropical forest comprise the main vegetation type, especially through the São Francisco river basin, with some enclaves occurring inside the *Cerrado* core area in the states of Goiás and Tocantins (see description of vegetation aspects in Werneck et al. 2009). In western Bahia, seasonally dry forests are interspersed with typical *Cerrado* vegetation, resulting in a complex landscape providing suitable microhabitats for species with different ecological requirements.

Because of its broad area and high environmental heterogeneity, the *Cerrado* shows a significant

turnover of amphibian species (Diniz-Filho et al. 2004). Based on the distribution of species in *Cerrado*, Diniz-Filho et al. (2007) stated that the peak of anuran richness occurs in central-southern region, decreasing toward the northeast. However, as suggested by Diniz-Filho et al. (2004), due to the uniqueness of the *Cerrado* / *Caatinga* contact zone in the western uplands of Bahia, this region is identified as one of the 10 priority areas for amphibian conservation in *Cerrado*, based on species distribution modeling, site complementarity analysis, and conservation efficiency.

Herein, we contribute to the knowledge of the *Cerrado* amphibian diversity by presenting a list of anuran species collected in the eastern part of the municipality of São Desidério, state of Bahia, with comments on the geographic distribution and habitat use of each species. We expect our data will help future studies on the biogeography of the *Cerrado* / *Caatinga* contact zone.

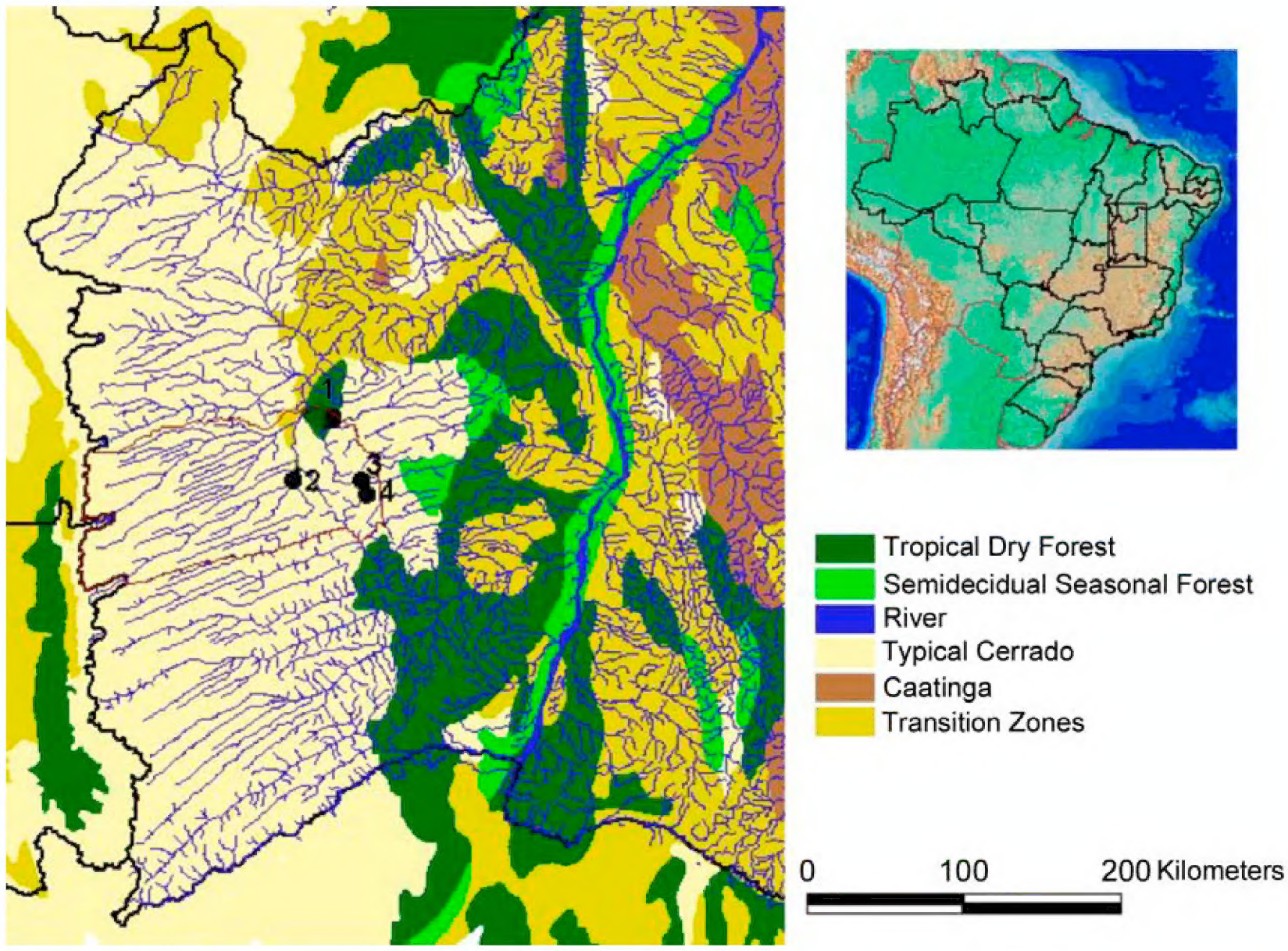


**Figure 1.** Sampled sites from the municipality of São Desidério, in western uplands of Bahia. Colors represent vegetation types (according to IBGE 2003). Numbers represent sampling sites: 1 - *Parque Municipal Lagoa Azul* and sorroundings; 2 - v*ereda do Anastácio*; 3 - *povoado de Campo Grande*; 4 - temporary ponds at the municipalities of São Desidério and Correntina boundaries.

## Materials and Methods

*Study Site*

The municipality of São Desidério is in *Chapadão Ocidental da Bahia* (the western uplands of Bahia), a flat, elevated plateau dominated by gently rolling grasslands on sandy interfluvial soils. Many springs flow through this region and drain into the São Francisco river. These tributaries run toward the east, almost parallel to each other, and reach a contact zone between seasonally dry tropical forests and savanna vegetation, in the lower altitudes of the eastern part of São Desidério. Calcareous rock outcrops are frequent through areas with a more steep relief. The western uplands of Bahia is among the most intensely exploited regions of the *Cerrado*, with high levels of habitat loss, especially due to the mechanized agricultural production of soybeans, cotton and corn. Collecting efforts were concentrated within 30 km on the eastern side of São Desidério. The following sites were sampled (see Figures 1 and 2):

1. *Parque Municipal Lagoa Azul* and surrounding areas: seasonally dry tropical forest area extending from the city of São Desidério to *Parque*

*Municipal Lagoa Azul*. Temporary ponds and flooded areas close to the São Desidério river were sampled, as well as marshy areas formed right after heavy rains (12°22' S, 44°51' W). Although we registered some amphibian species inside the park, especially close to the *Gruta do Catão*, we did not collect any specimens inside the protected area.

2. *Rio Grande* and *Vereda do Anastácio* marginal ponds: ponds, seasonally flooded grasslands and adjacent typical cerrado patches along *Rio Grande* (12°42' S, 45°05' W).

3. Temporary and permanent ponds close to *povoado de Campo Grande*, along the recently paved road from the municipality of Correntina to São Desidério (12°44' S, 44°41' W).

4. Temporary ponds close to the boundary of Correntina and São Desidério municipalities, along the recently paved road from Correntina to São Desidério, 20-30 kilometers south from site 3 (13°01' S, 44°36' W).

*Data collection*

We conducted two field trips to São Desidério, one at the beginning of the rainy season, from October 31 to November 6, 2007, and a second trip in the peak of the rainy season, from January 15 to 19, 2008. All areas were sampled at least twice in each field trip. Amphibians were sampled at night by active search (visual and acoustic), which is considered the most efficient way to get the largest number of species in the least amount of time. This method involves tracing each call to its source and capturing at least one voucher specimen of each species by hand from all possible microhabitats. (Scott-Jr 1994). Voucher specimens were collected (Permit number 02001.001238/2007-52) and deposited at *Coleção Célio Fernandes Baptista Haddad – Universidade Estadual Paulista, Campus Rio Claro* (CFBH) and *Coleção Herpetológica da Universidade de Brasília* (CHUNB).

**Results and Discussion**

We found 32 anuran species, belonging to 12 genera in five families. Hylidae was the richest family (ten species) followed by Leiuperidae and Leptodactylidae (eight species each), Bufonidae (five species), and Microhylidae (two species). Eight species (25 %) are endemic to *Cerrado*, three (9 %) are shared with *Caatinga* biome, two (6 %) shared with Atlantic Forest, and eighteen (56 %) are widespread through adjacent biomes (Table 1, Figures 3 to 5).

Twenty-six of the 32 species were found calling and six other species were collected only by visual search. These may reproduce in non-sampled sites, in a non-sampled time of the year, or they may call only under special climatic conditions. Although not present in our list, *Pseudopaludicola saltica*, found in the adjacent municipalities of Barreiras and Jaborandi, could also occur in São Desidério.

This is the first record of *Leptodactylus sertanejo* apart from its type locality, in municipality of Uberlândia, state of Minas Gerais (Giaretta and Costa 2007). Our record extends its distribution more than 750 km to the northeast. We also fill gaps in the distribution of the recently described *Rhinella veredas* and *R. cerradensis* (see distribution maps in Brandão et al. 2007 and Maciel et al. 2007, respectively). Additionally, we add two new records to the *Cerrado* species list in Colli et al. (2002), *Physalaemus albifrons* and *Pleurodema diplolistris*. Until now, both of them were considered typical of the *Caatinga* biome.

Although the western uplands of Bahia do not show high levels of endemism (Diniz-Filho et al. 2007; this study) or diversity like other localities in the southeastern *Cerrado* (Diniz-Filho et al. 2004), they represent an important area in this biome as they harbor many species unique to this region occurring in the threatened seasonally dry forest and shared between *Cerrado* and *Caatinga*. This confirms the selection of this region as a priority area for conservation by a simple "greedy" algorithm based on area complementarity (Diniz-Filho et al. 2004).

Most of the registered species are habitat generalists, such as *Leptodactyus* cf. *chaquensis*, *L. troglodytes*, *Phyllomedusa azurea*, and *Hypsiboas albopunctatus*. However, we found some forest-associated species, such as *Rhinella* cf. *pombali* and *Leptodactylus mystaceus*, and grassland or other open area specialists such as *Leptodactylus sertanejo* and *Rhinella veredas*.

Marked seasonality and high spatial heterogeneity are two aspects that have profound effects on the life history and distribution of anurans in *Cerrado* habitats (Colli et al. 2002). Thus, local communities can harbor widespread species with varied ecological requirements occurring in *Cerrado* and adjacent biomes as observed in São Desidério.

**Table 1.** List of species sampled from São Desidério with sites where each was found, collecting method and habitat type. e = *Cerrado* endemic; w = widespread; ca = *Cerrado* and *Caatinga* inhabitant; af = *Cerrado* and Atlantic Forest inhabitant. DF = ponds or temporary lakes in dry forest; VE = *vereda* and associated marshes; GR = grasslands, TP = temporary ponds in open areas.

| Amphibian species | Sites | Habitat | Method |
|---|---|---|---|
| **Family Bufonidae (5)** | | | |
| *Rhinella cerradensis*[e] Maciel, Brandão, Campos and Sebben, 2007 | 2 | VE | visual |
| *Rhinella* cf. *pombali*[af] | 1 | DF | acoustic |
| *Rhinella mirandaribeiroi*[w] (Spix, 1824) | 2 3 4 | TP | acoustic |
| *Rhinella schneideri*[w] (Werner, 1894) | 1 2 3 4 | TP DF VE | acoustic |
| *Rhinella veredas*[e] (Brandão, Maciel, and Sebben, 2007) | 2 3 4 | VE | visual |
| **Family Hylidae (10)** | | | |
| *Dendropsophus minutus*[w] (Peters, 1872) | 1 3 | TP | acoustic |
| *Dendropsophus nanus*[w] (Boulenger, 1889) | 1 2 3 4 | DF TP VE | acoustic |
| *Dendropsophus rubicundulus*[e] (Reinhardt and Lütken, 1862) | 2 3 | TP | acoustic |
| *Dendropsophus melanargyreus*[w] (Cope, 1887) | 1 | DF | acoustic |
| *Hypsiboas albopunctatus*[w] (Spix, 1824) | 1 2 3 | VE | acoustic |
| *Hypsiboas crepitans*[w] (Wied-Neuwied, 1824) | 1 4 | DF | acoustic |
| *Hypsiboas raniceps*[w] Cope, 1862 | 1 4 | TP | acoustic |
| *Phyllomedusa azurea*[e] Cope, 1862 | 1 2 3 4 | DF TP | acoustic |
| *Scinax fuscomarginatus*[w] (Lutz and Lutz, 1939) | 1 2 4 | TP VE | acoustic |
| *Scinax* sp. gr. *ruber* | 1 2 4 | TP VE | acoustic |
| **Family Leiuperidae (8)** | | | |
| *Eupemphix nattereri*[e] Steindachner, 1863 | 1 4 | DF TP | acoustic |
| *Physalaemus albifrons*[ca] (Spix, 1824) | 2 | VE | visual |
| *Physalaemus centralis*[e] Bokermann, 1962 | 2 4 | TP VE | acoustic |
| *Physalaemus cuvieri*[w] Fitzinger, 1826 | 2 | TP VE | acoustic |
| *Physalaemus marmoratus*[af] (Reinhardt and Lütken, 1862) | 3 4 | TP | acoustic |
| *Pleurodema diplolister*[ca] (Peters, 1870) | 1 2 | TP GR | visual |
| *Pseudopaludicola ternetzi*[e] Miranda-Ribeiro, 1937 | 2 | TP VE | acoustic |
| **Family Leptodactylidae (8)** | | | |
| *Leptodactylus hylaedactylus*[w] (Cope, 1868) | 1 | DF | acoustic |
| *Leptodactylus fuscus*[w] (Schneider, 1799) | 1 2 4 | DF VE TP GR | acoustic |
| *Leptodactylus labyrinthicus*[w] (Spix, 1824) | 4 | VE | acoustic |
| *Leptodactylus* cf. *chaquensis*[w] | 1 2 3 4 | DF TP VE | visual |
| *Leptodactylus mystaceus*[w] (Spix, 1824) | 1 4 | DF | acoustic |
| *Leptodactylus podicipinus*[w] (Cope, 1862) | 1 4 | DF TP | acoustic |
| *Leptodactylus sertanejo*[e] Giaretta and Costa, 2007 | 2 | GR | acoustic |
| *Leptodactylus troglodytes*[ca] Lutz, 1926 | 2 3 4 | DF TP | acoustic |
| **Family Microhylidae (2)** | | | |
| *Dermatonotus muelleri*[w] (Boettger, 1885) | 1 | DF | visual |
| *Elachistocleis ovalis*[w] (Schneider, 1799) | 4 | TP VE | acoustic |

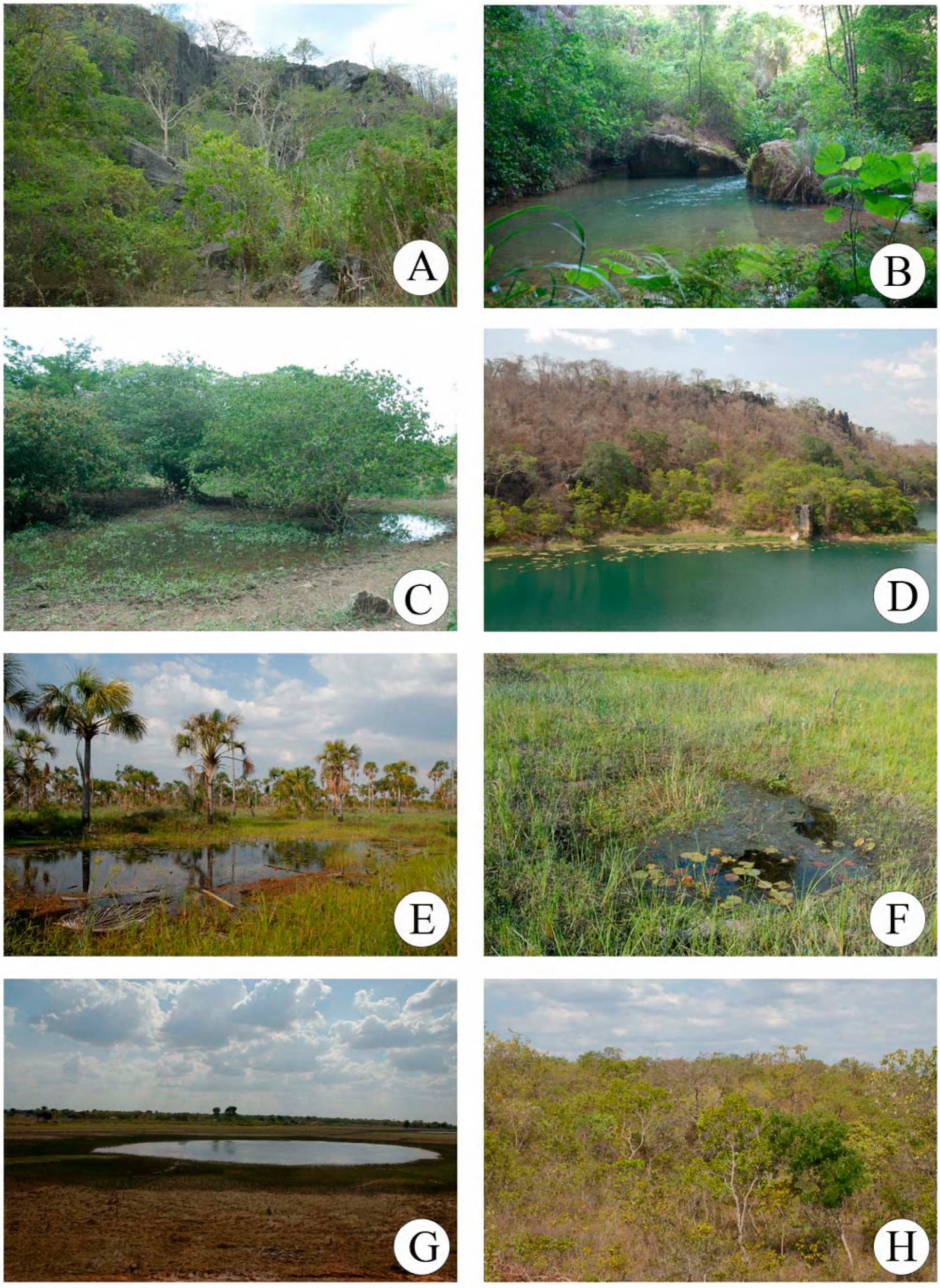


**Figure 2.** Sampling sites at São Desidério, state of Bahia. A. Rock outcrops and seasonally dry forest; B. Permanent pond at *Parque Municipal Lagoa Azul*; C. Temporary pond at São Desidério river flooded margins; D. Sinkhole and temporary dry forest at *Parque Municipal Lagoa Azul*; E. *Vereda do Anastácio*; F. *Vereda do Anastácio*; G. Permanent pond at Campo Grande; H. Typical *cerrado* crossed by the road to Correntina. Photo: P. H. Valdujo.

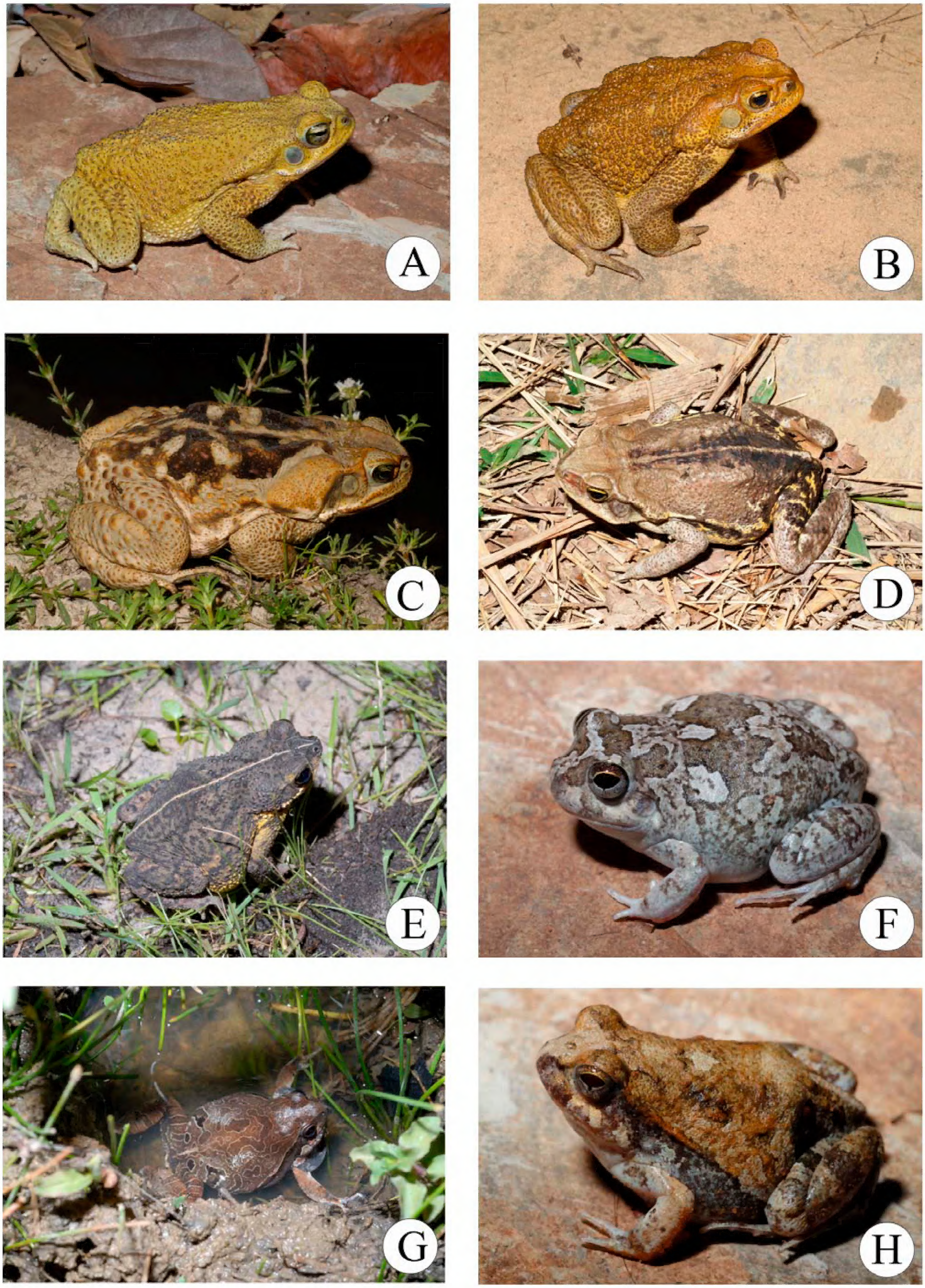


**Figure 3.** Bufonid species: A. *Rhinella veredas*; B. *Rhinella cerradensis*; C. *Rhinella schneideri*; D. *Rhinella* cf. *pombali*; E. *Rhinella mirandaribeiroi*; Leiuperid species: F. *Pleurodema diplolister*; G. *Physalaemus centralis*; H. *Physalaemus albifrons*; collected in the municipality of São Desidério, state of Bahia. Photo: P. H. Valdujo.

**Figure 4.** Leptodactylid species: A. *Leptodactylus troglodytes*; B. *Leptodactylus sertanejo*; C. *Leptodactylus* cf. *chaquensis*; D. *Leptodactylus mystaceus*. Leiuperid species: E. *Eupemphix nattereri*; F. *Pseudopaludicola ternetzi.* Microhylid species G. *Elachistocleis ovalis*; H. *Dermatonotus muelleri*; collected in the municipality of São Desidério, state of Bahia. Photo: P. H. Valdujo.

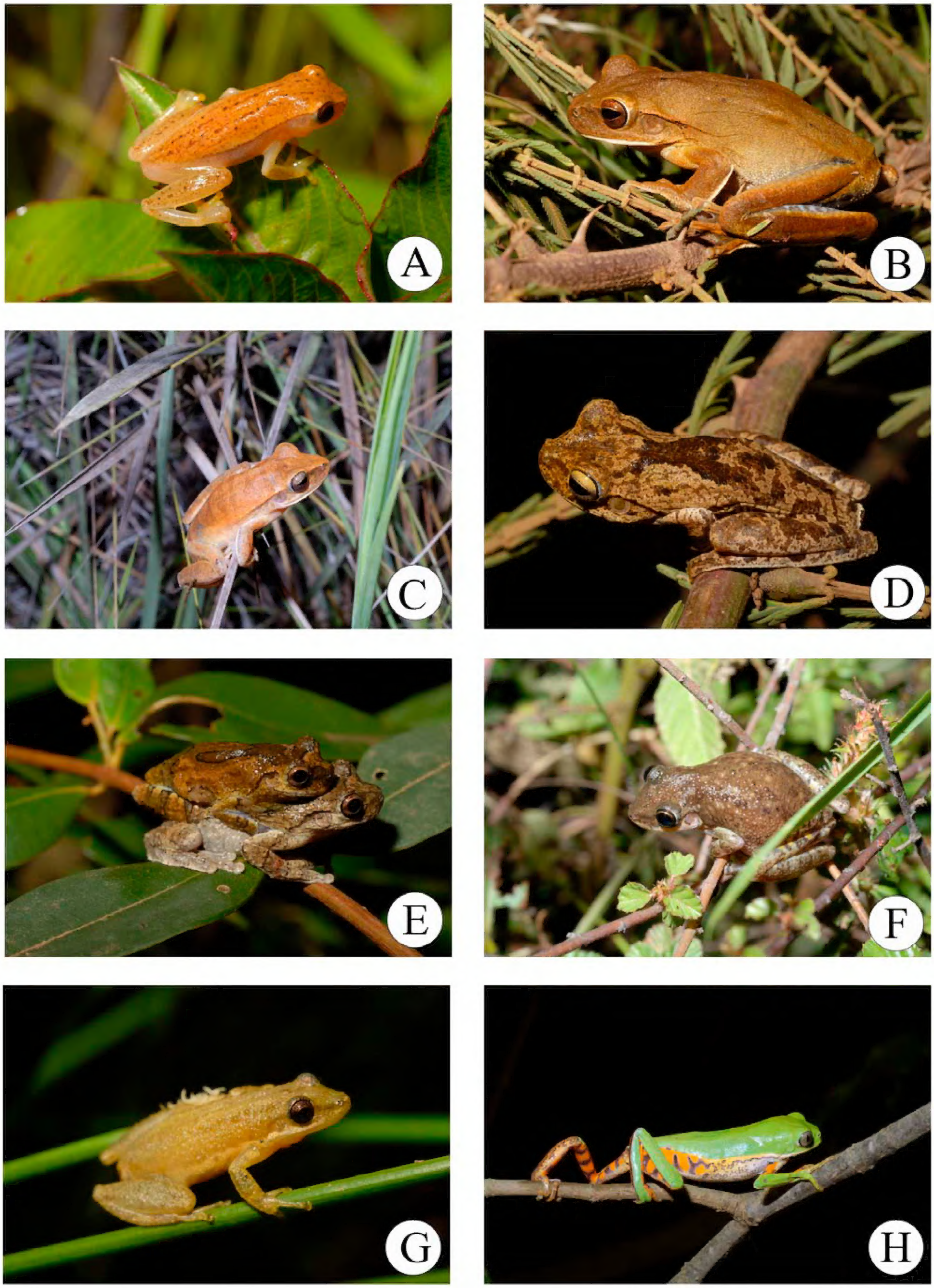


**Figure 5.** Hylid species collected in the municipality of São Desidério, state of Bahia. A. *Dendropsophus nanus*; B. *Hypsiboas raniceps*; C. *Hypsiboas albopunctatus*; D. *Hypsiboas crepitans*; E. *Dendropsophus melanargyreus*; F. *Scinax sp.* gr. *ruber*; G. *Scinax fuscomarginatus*; H. *Phyllomedusa azurea*. Photo: P. H. Valdujo.

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**Appendix 1.** Voucher specimens

*Rhinella cerradensis* (CHUNB 51113); *Rhinella* cf. *pombali* (CHUNB 51109), *R. granulosa* (CFBH 20544); *R. schneideri* (CHUNB 51115); *R. veredas* (CFBH 20516); *Dendropsophus minutus* (CFBH 20536); *D. nanus* (CFBH 20564); *D. rubicundulus* (CFBH 20533); *D. melanargyreus* (CFBH 20518); *Hypsiboas albopunctatus* (CHUNB 50989); *H. crepitans* (CFBH 20526); *H. raniceps* (CFBH 20525); *Phyllomedusa azurea* (CFBH 20557); *Scinax fuscomarginatus* (CFBH 20537); *Scinax* sp gr *ruber* (CFBH 20563); *Eupemphix nattereri* (CFBH 20531); *Physalaemus albifrons* (CHUNB 51061) *P. centralis* (CFBH 20539); *P. marmoratus* (CFBH 20562); *Pleurodema diplolistris* (CHUNB); *Pseudopaludicola ternetzi* (CHUNB); *Leptodactylus fuscus* (CFBH 20566); *L. labyrinthicus* (CHUNB 51138); *L. chaquensis* (CFBH 20514); *L. mystaceus* (CFBH 20555); *L. podicipinus* (CHUNB 51037); *L. sertanejo* (CFBH 20558); *L. troglodytes* (CFBH 20532); *Dermatonotus muelleri* (CFBH 20529); *Elachistocleis ovalis* (CFBH 20565).